Forest Research Notes

Northeastern Forest Experiment Station

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AUTOMATIC DEVICES TO TAKE WATER SAMPLES AND TO RAISE TRASH SCREENS AT WEIRS

Experimentation on small watersheds is assuming increasing importance in watershed-management research. Much has been accomplished in developing adequate instrumentation for use in these experiments. Yet many problems still await solution. One difficulty encountered is that small streams are subject to wide variations in flow and that these variations are generally unpredictable; so it is often impossible for personnel to be on the spot at the right time to take samples or to service installations.

This paper describes devices we have developed to take water-quality samples and to manipulate weir trash screens. These devices, installed at weirs on the Fernow Experimental Forest in West Virginia and the Hubbard Brook Experimental Forest in New Hampshire, operate automatically when streamflow reaches predetermined stages.

The Tripping Device

Both the sediment sampler and the trash-screen lifter are activated by a tripping device that operates when the water level reaches a predetermined height. The tripping device (figs. 1 and 2) consists of a 5-quart can, half filled with concrete, which rides up and down along taut vertical wires fastened to concrete blocks set in the bottom of the weir, and overhead to a board that overhangs the top of the side wall. These guide wires pass through tubes soldered to opposite sides of the can.

At low water the can floats about 1 inch above the water surface. As the water rises, the can rises with it until it strikes an adjustable metal stop. Prevented from rising farther, the can then fills with water and sinks to the bottom of the weir.

A cord attached to the can is pulled down by the weight of the sinking can. This cord pulls a trigger that activates the sediment sampler or the trash-screen lifter.

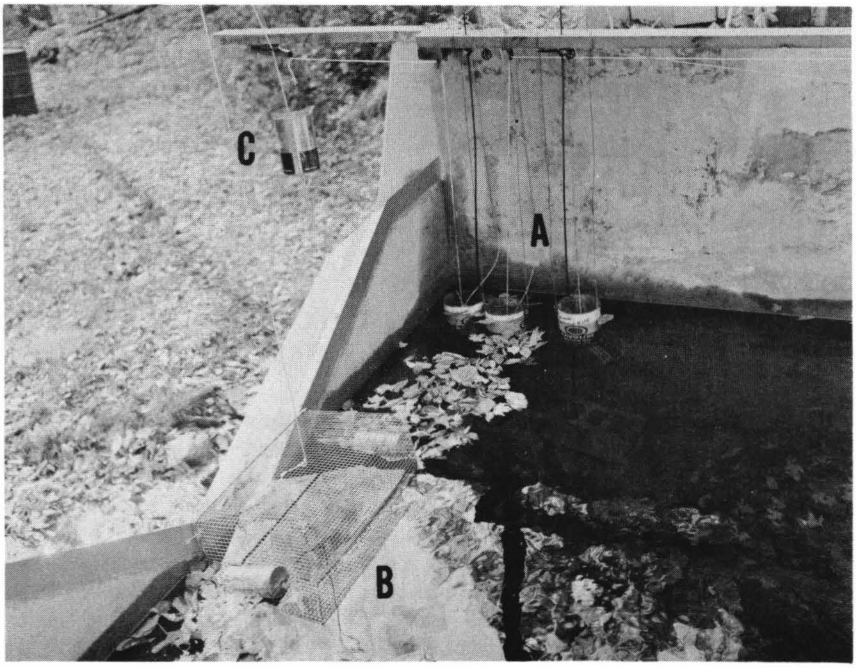
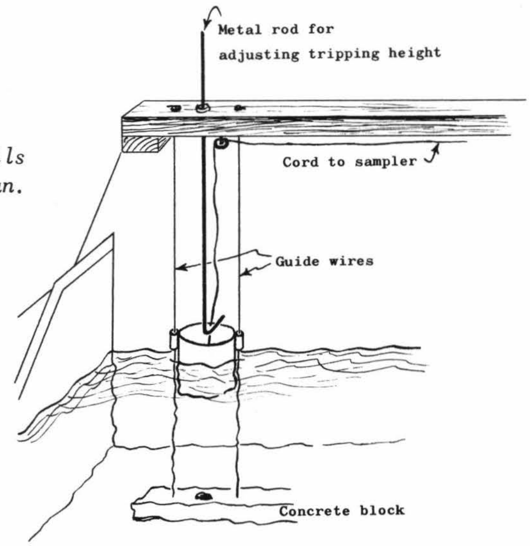


Figure 1.--*Tripping cans (A) and trash screen (B) in place in weir. The trash-screen weight (C) is suspended outside the cutoff wall.*

Figure 2.--*Details of a tripping can.*



The Sediment Sampler

Sediment discharge from a watershed is generally classified as bedload or suspended sediment. Measuring the volume of material removed in periodic weir cleanings gives a rough estimate of bedload movement of rocks, pebbles, and gravel. Soil moved in suspension is measured by periodic collection and analysis of water samples.

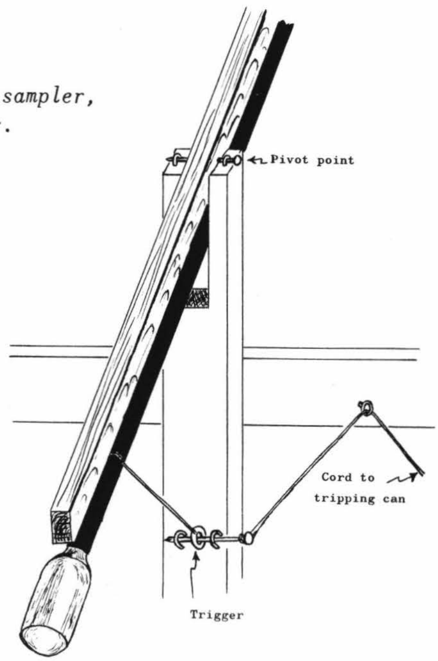
Highest concentrations of suspended sediment usually occur during rapidly rising stages of streamflow. In remote watersheds, these stages may be over before a man can reach the sampling point. A single-stage sampler developed at the

Figure 3.--*Sediment samplers in operation. Top: both the samplers are empty and ready to trip. Bottom: the low-stage sampler has tripped, and the hose is resting in the flume.*

St. Anthony Falls Hydraulic Laboratory[1] has not been effective in our small turbulent streams; and other automatic samplers require electric motors and timers.[2]

Our sampler operates off a flume of 5-inch gutter pipe used to divert a portion of the stream into the sampler, which is located to the rear of the debris basin. The sampler consists of a hose, 1 to $1\frac{1}{2}$ inches in diameter and about 3 feet long, which is attached to a plastic quart bottle, both strapped to a board 1 inch wide (fig. 3). This board is balanced on a pivot.

Figure 4.--*Details of sediment sampler, showing pivot point and trigger.*



Prior to sampling, the board, hose, and empty bottle are in a nearly vertical position (fig. 3). The sampler is held from falling into the flume by a wire joining the bottle to a trigger mechanism. This trigger consists of a washer attached to the wire, a nail which passes through the washer, and staples that keep the nail in a horizontal plane. When the nail is pulled out of the washer, the sampler falls and the hose lands in the water running in the

[1]A study of methods used in measurement and analysis of sediment loads in streams. Subcommittee on Sedimentation, Federal Interagency Committee on Water Resources Report AA. 38 pp., May 1959.

[2]Developed by the Michigan State Water Resources Commission; cited by E. C. Tsivoglou, E. D. Harward, and W. M. Ingram in Stream surveys for radioactive waste control, Jour. Amer. Water Works Assoc. 49: 750-766, 1957.

flume. A length of nylon cord (which does not expand in water) connects the trigger (fig. 4) to the tripping can.

When the sampler is tripped (fig. 3), the hose falls in the flume, and water runs into the bottle. The device is sensitively balanced so that, when the bottle is filled, its weight tips the hose upward out of the flume. The open end of the hose is cut at a sharp angle to provide an overhang that prevents dilution of the sample by rainfall. The sample can be poured from the bottle without removing it from the board.

With one sampling rig and one tripping can, it is possible to obtain samples at different stages of flow by changing the height of the tripping can stop. If samples are to be taken at several stages during the same storm, a battery of samplers can be built. Each requires its own tripping can.

The Trash-Screen Lifter

Every autumn, in regions having hardwood cover, leaves and twigs fall or float into weir basins. In periods of low flow, these become lodged in the V-notch and cause erroneous readings on the hydrograph. A wire trash screen

Figure 5.--*The trash screen in place. Counterweight and trigger for screen lifter are at left.*

placed immediately upstream of the V-notch keeps leaves and twigs out of it. Most screens are rectangular in shape, with screen mesh on the top, the two ends, and the upstream side. Screens usually are held in place by hooks over the weir blade.

When height of flow increases, the screen must be removed to make certain it does not obstruct flow from the V-notch and also to prevent formation of an artificial head of water behind the debris trapped by the screen. At higher flows, leaves and other small debris are usually flushed through the notch and cause no malfunction.

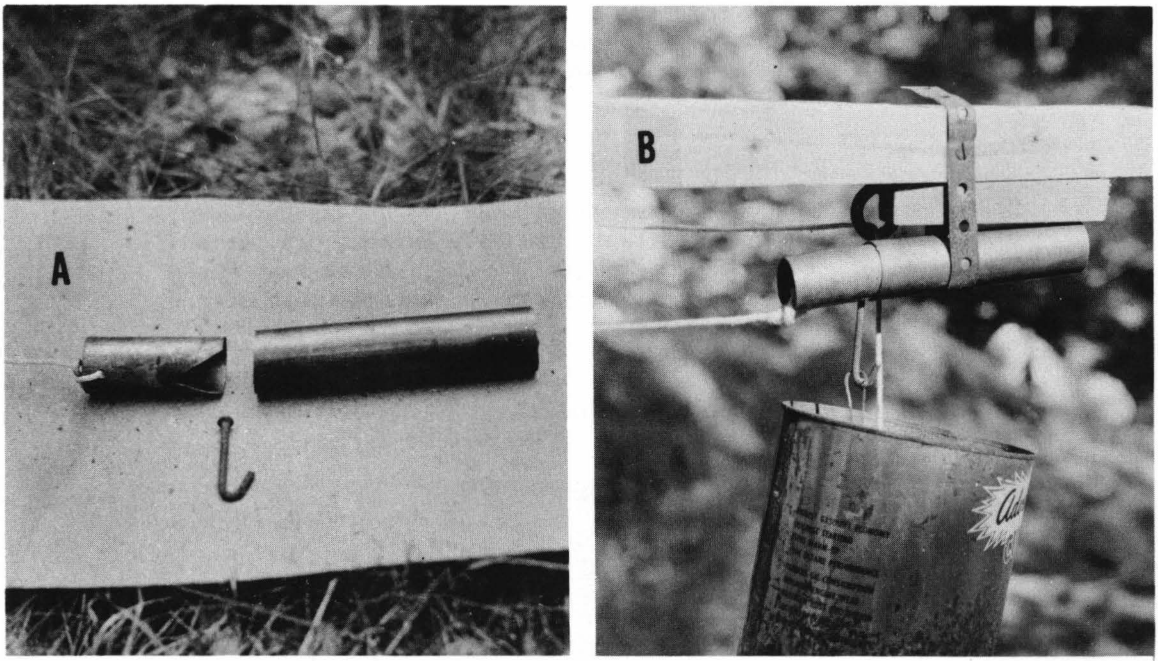


Figure 6.--*The trigger. A, its components. B, in position, holding up counterweight.*

In our experience, trash screens should be removed when the head of water is between 0.2 and 0.3 foot. Because screens must be removed promptly when the water begins to rise, it is convenient to have them pulled up automatically.

Trash screens in use at the Hubbard Brook Experimental Forest are 30 inches long, 12 inches wide, and 9 inches high. They are constructed of $\frac{1}{2}$-inch wire mesh. Two floats keep the screen riding about half out of the water, and two wire hooks over the weir blade keep it centered around the notch. A screen of this size does not obstruct discharge up to 0.4 foot.

The automatic screen lifter consists of a counterweight (a cement-filled bucket, a sash weight, or any heavy metal weight), attached to the screen by a cord running through a pulley mounted about 5 feet above the notch. The counterweight, suspended outside the cutoff wall, is kept from falling by a trigger.

The trigger (figs. 5 and 6) consists of two tubes, the larger one strapped with a metal band to a board that overhangs the cutoff wall and is bolted to the side wall. The smaller tube fits loosely into the larger. One end of the smaller tube has a notch cut into it, about 1 inch long; the other end is attached by a cord to a tripping can.

A hook (made of a bent flat-headed nail) is fastened with a wire to the counterweight. The flat head of this hook is placed in the notch, and the smaller tube is inserted into the larger tube until the hook is engaged in the notch, thus suspending the counterweight in the air. When the tripping can pulls the small tube back, the hook is released from the notch, and the counterweight falls to the ground; as it does, the cord, running through the pulley, pulls the trash screen up about 2 feet above the side wall of the weir and holds it there.

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